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Office of Science and Technology

Marine Recreational Information Program

Evaluating Uncertainty in Gulf Red Snapper Estimates

A Preliminary Sensitivity Analysis of Non-Sampling Errors in the Region's Recreational Fishing Surveys

Key Points

- Non-sampling errors can account for the differences in red snapper landings estimates for private boat mode among the state and regional monitoring programs in the Gulf of Mexico.
- Using the same or very similar designs in all states can produce comparable relative distributions of estimates. Using different designs increases the likelihood that results will not be directly comparable.
- Results presented are informative but not definitive. They do not eliminate the possibility of additional unidentified non-sampling errors that could mitigate effects described here.

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Errors Affect All Surveys

Not even the 'perfect survey,' with a **scientifically rigorous design** based on **sound statistical theory**, will be error-free when it's implemented in the real world.

- **Non-sampling errors** can be random or systematic; when systematic, they create bias or consistent differences between estimates and actual population values.
  - The direction and magnitude of non-sampling errors can vary significantly among survey designs.
  - Assessing non-sampling error and "correcting" estimates is challenging.

While the information we currently have cannot tell us which Gulf survey program is most accurate, it can help us understand **how non-sampling errors may be driving differences between the estimates**.

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Gulf of Mexico Recreational Fishing Surveys

General Design	Survey Program	Methods	Comparisons to MRIP APAIS-FES red snapper landings estimates for private boat mode
Intercept survey at public access fishing sites coupled with an offsite effort survey	**MRIP APAIS and FES** MS to FL, 2015-Present (Discontinued in LA in 2016)	• Intercept survey coupled with a **mail survey** distributed to sample of residential households.	–
	MRIP APAIS and CHTS MS to FL, 1981-2017 (2013 APAIS design change)	• Intercept survey coupled with a **telephone survey** of sample of residential households.	⇩
	LA Creel Louisiana, 2014-Present	• Intercept survey coupled with **telephone and email surveys of licensed anglers**.	⇩
	State Reef Fish Survey Florida, 2015-Present (Expanded from Gulf Coast only to full state in 2020)	• Intercept survey coupled with **a mail survey distributed to sample of designated anglers' households**.	⇩
Intercept survey only	**Coastal Creel Survey** Texas, 1974-Present (with design changes until 1983)	• Intercept survey with anglers at public boat access sites.	⇩⇩⇩
Capture-recapture	**Tails n' Scales** Mississippi, 2015-Present	• **Capture:** Mandatory electronic trip reports of boats landing red snapper. • **Recapture:** Intercept survey with anglers to validate reports, measure reporting rates, and account for mis-reported or unreported trips.	⇩⇩
	Snapper Check Alabama, 2014-Present		

Preliminary Sensitivity Analysis

To explore how non-sampling errors may be driving differences between estimates of **recreational private boat red snapper landings**, we simulated the presence of non-sampling errors in the MRIP APAIS-FES estimates and compared the results to state program data.

Simulated Non-sampling Errors:

1. **Non-response Error**: Occurs when a sample member is unable or unwilling to respond to a survey and has different characteristics than those who do respond.
    i. People who don't respond to a survey may fish more or less often—or catch more or less fish—than those who do.

2. **Coverage Error:** Occurs when members of the target population are **omitted**, duplicated, or wrongly included in a sample frame.
    i. Landline-based sample frames omit members of the target population who don't have or answer landline telephones.
    ii. License-based sample frames omit members of the target population who fish without a license.
    iii. Intercept survey designs that collect information at public access sites omit members of the target population who fish from private access sites.

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Can Non-response Error in the MRIP FES Explain the Differences between MRIP and State Program Estimates?

For non-response error in the MRIP FES to be driving the differences between MRIP estimates and the state programs' estimates, **two assumptions would have to be true**:

1. State programs are not susceptible to non-response error.
   - This assumption is **not supported** given that no program has a 100% response rate.
     - Note: Response rates alone cannot predict the presence or magnitude of non-response error, but higher response rates decrease the risk of this error.
2. The MRIP FES suffers from maximum non-response error (i.e. that all non-respondent households have zero fishing activity).
   - This assumption is **not supported** by the results of two FES non-response follow-up studies.

Surveys	Response/Compliance Rate (2019)
MRIP FES (Mail)	31.2% (42.2% in a 2020 non-response follow-up study)
FL State Reef Fish Survey (Mail)	21%
LA Creel (Telephone)	50.5%
AL Snapper Check (App)	51.4%
MS Tails n' Scales (App)	95%

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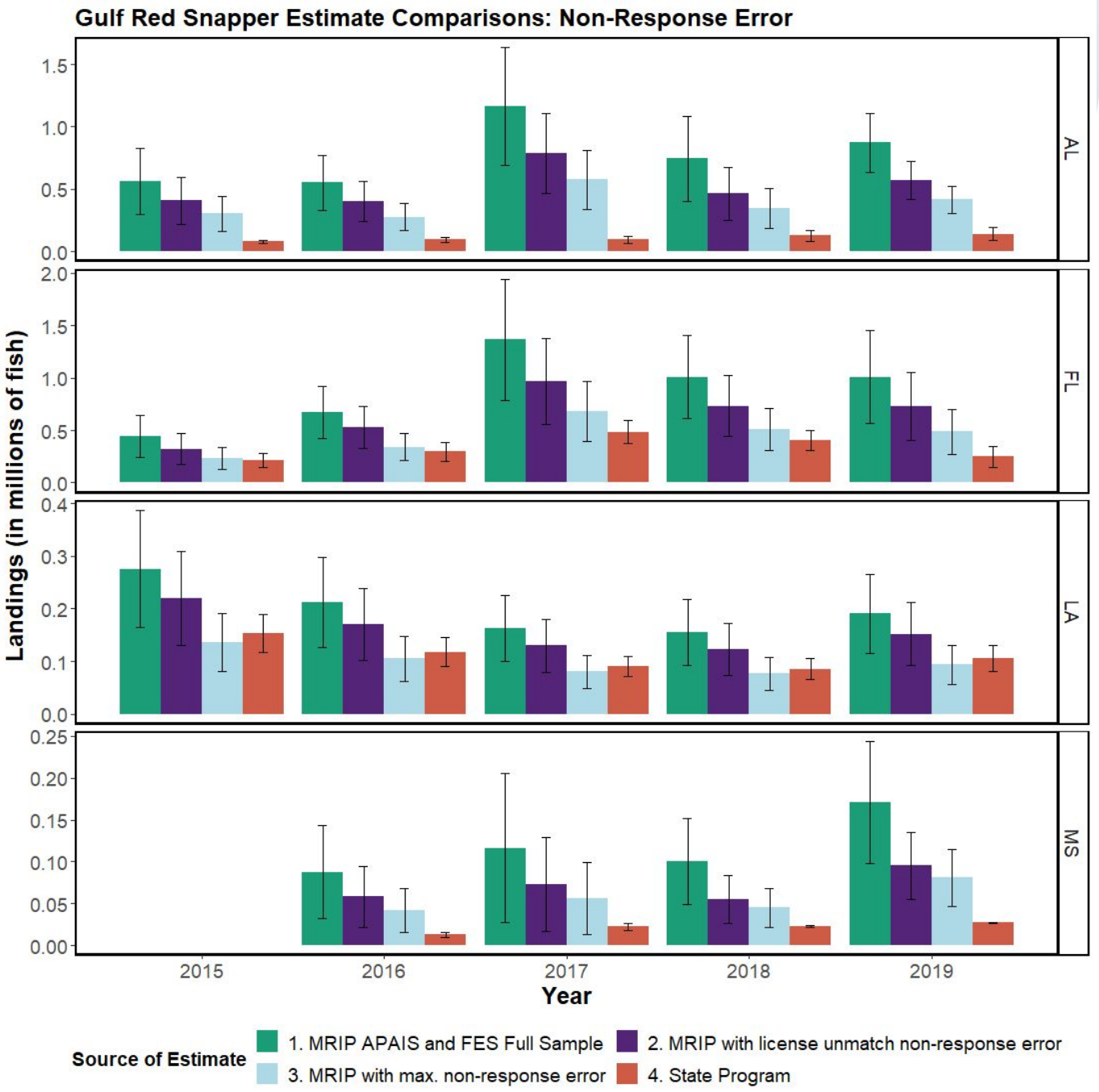
Simulating Possible Effects of Non-response Error

How: Using the MRIP FES response rates, we can simulate how much lower MRIP estimates would be if we assume that the FES currently suffers from maximum non-response error in either all households or only in the unlicensed households.

Results: When applying the maximum adjustment (which research does not support), values are **similar to LA Creel estimates**, but **still systematically higher than FL SRFS estimates, and much higher than AL Snapper Check and MS Tails n' Scales estimates**.

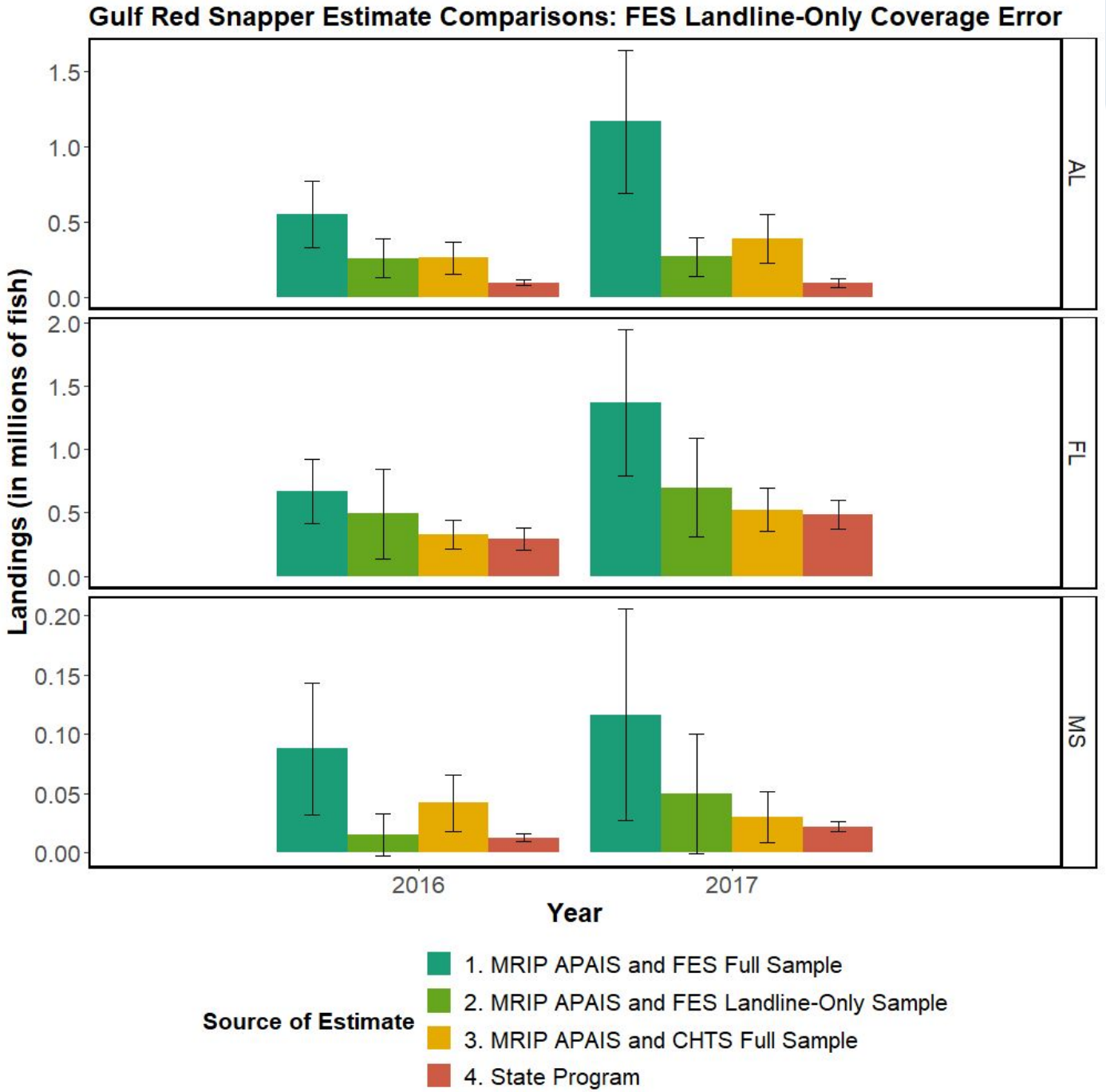
These hypothetical results suggest differences between MRIP and state program estimates cannot be fully explained by MRIP FES non-response error.



Simulating Landline-Only Coverage Error

How: Because **the MRIP FES asks respondents whether they have a landline telephone at home**, we can form a landline-only domain to produce estimates that simulate landline-only coverage error.

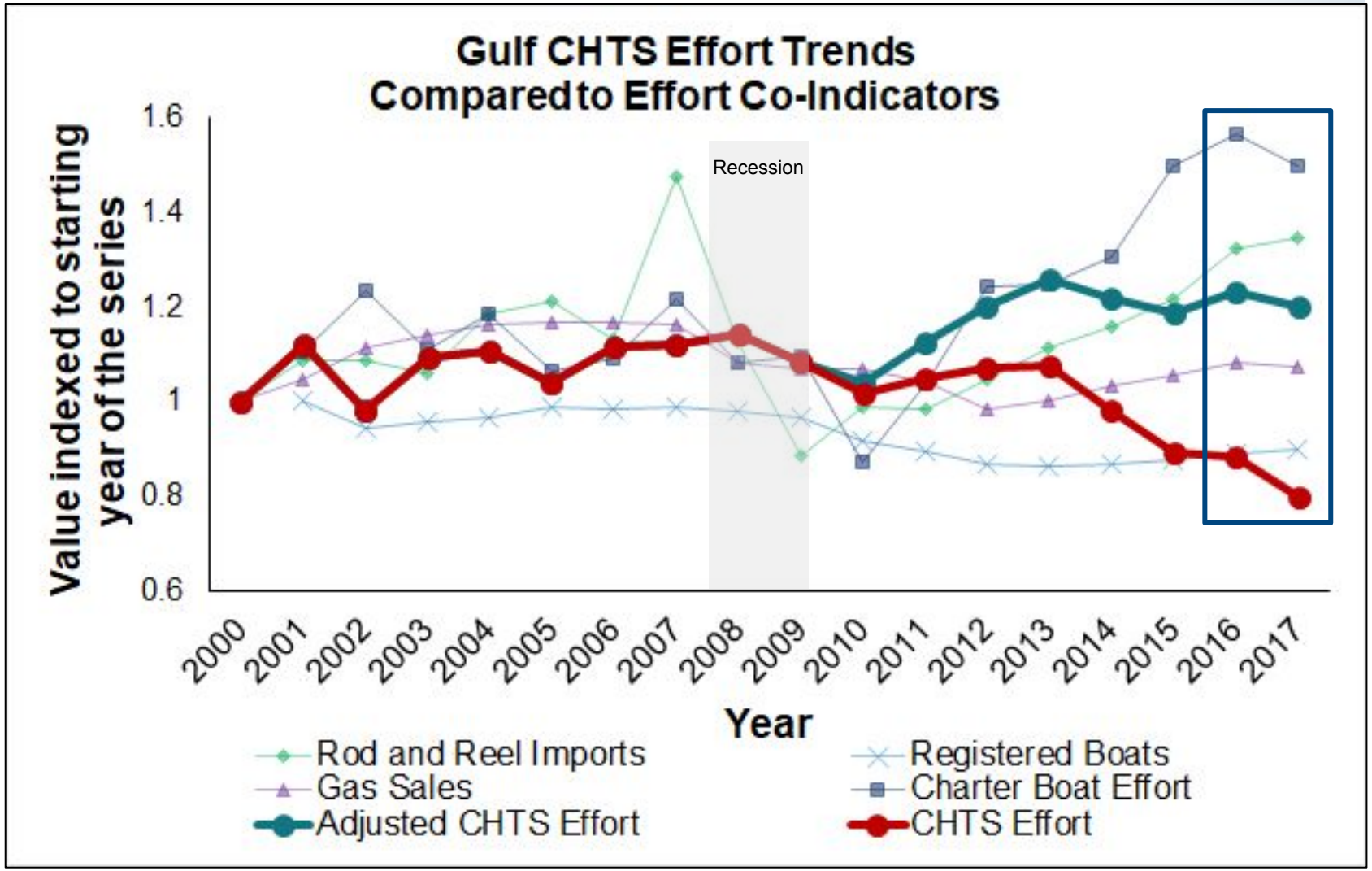
Results: When MRIP APAIS-FES estimates are modified to resemble those that would be produced by a program that omits population members who don't have a landline telephone at home—such as the MRIP CHTS—we see a **large negative bias**.



Evidence Suggests Growing Non-sampling Errors Impacted MRIP APAIS-CHTS Estimates in Final Years

The declining trend in CHTS effort was inconsistent with co-indicators of fishing activity following the 2008 recession, and likely the result of **growing non-sampling errors in the survey.**

We can adjust the CHTS series to approximate the recovery pattern of the indicators to simulate a similar post-recession recovery.

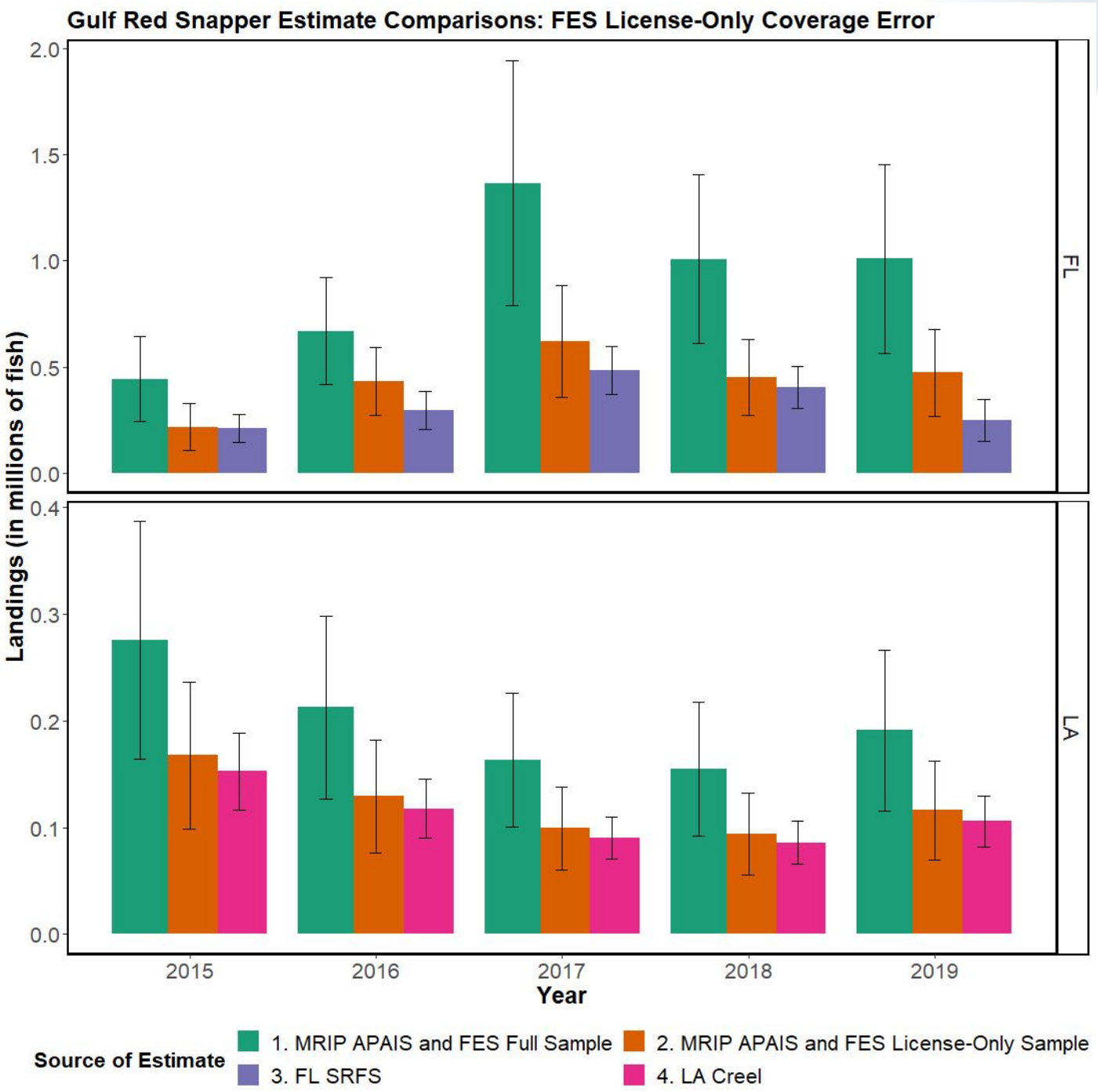


Simulating License-Only Coverage Error

How: Because **the MRIP FES stratifies households based on their match to an entry in state fishing license databases**, we can produce estimates that simulate license-only coverage error.

Results: When MRIP APAIS-FES estimates are modified to resemble those that would be produced by a program that omits unlicensed fishing effort (or has a highly biased coverage adjustment), we see a **large negative bias**.

While LA Creel and FL SRFS do use correction factors to adjust for license-only coverage error, these correction factors are derived from potentially sensitive survey questions about license status.

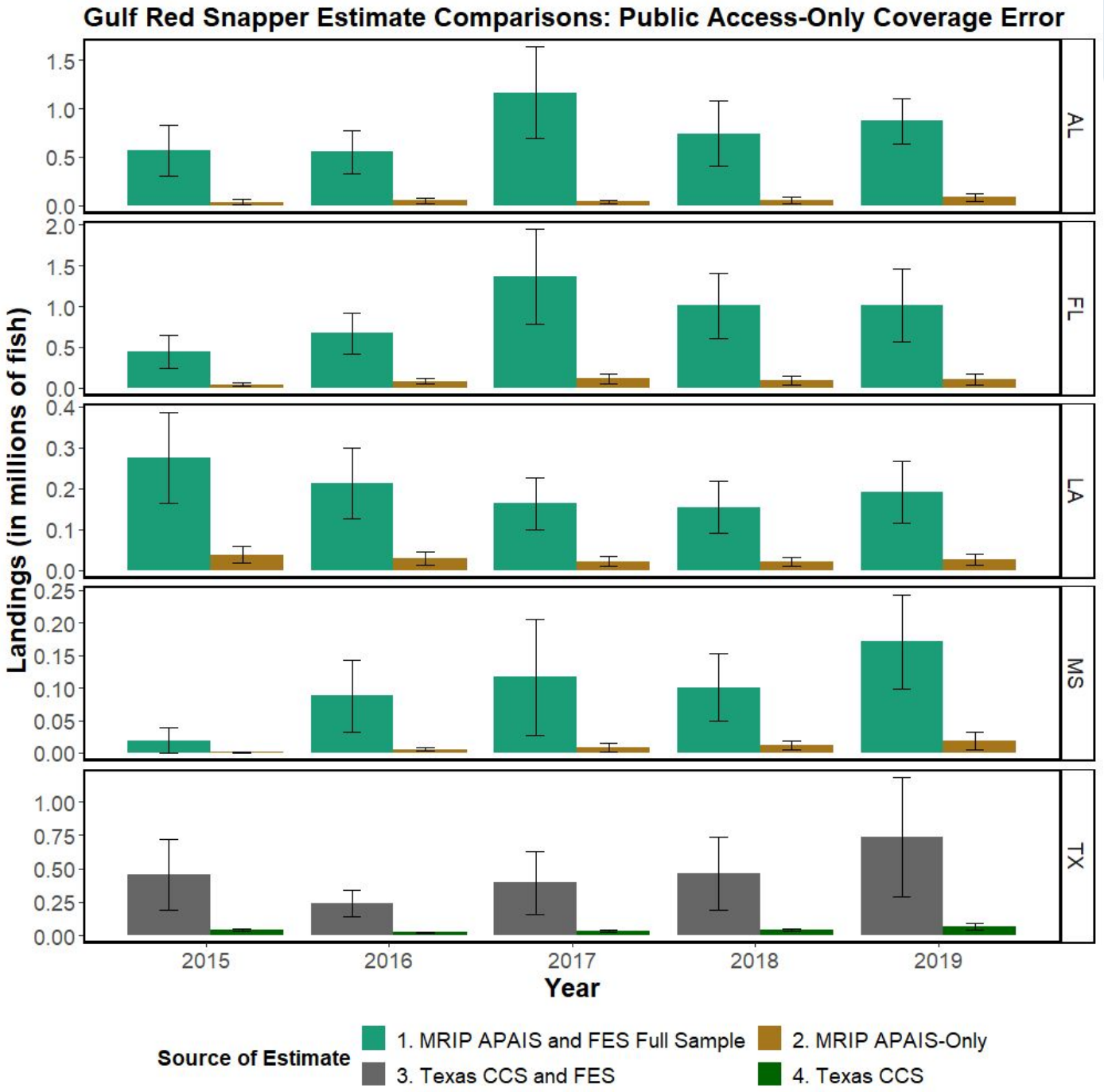


Simulating Public Access-Only Coverage Error

How: Because **MRIP APAIS-FES estimates are produced through a dual survey design** meant to account for both public and private access fishing, we can produce APAIS-only estimates to simulate coverage error resulting from omitting individuals who fish from private access sites.

Results: When MRIP APAIS-FES estimates are modified to resemble those that would be produced by a program that uses just one public access site intercept survey to collect data—similar to the Texas Coastal Creel Survey—we see a **large negative bias**.

Results also suggest the implementation of a dual survey design in Texas—wherein an independent survey like the MRIP FES would collect effort data—would produce **much larger estimates**.



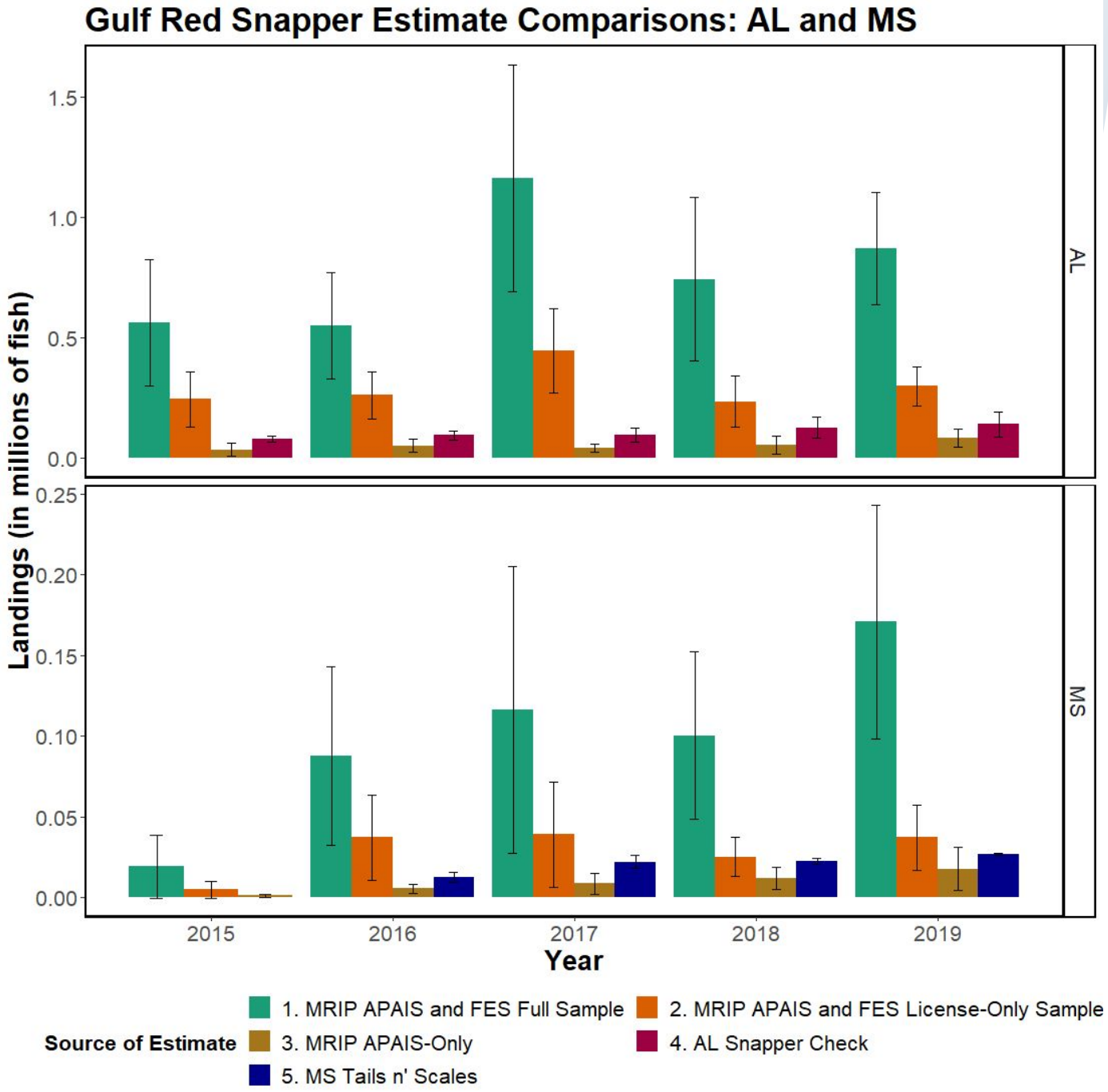
Possible Non-sampling Errors in AL and MS

Results can't suggest specific sources of non-sampling error in either program.

Potential sources include:

- Coverage error related to differences in reporting and/or trip characteristics between public and (non-sampled) private fishing access sites.
- Errors resulting from violations of the assumption of independence between the capture and recapture phases of data collection.

We can't effectively simulate these errors in MRIP APAIS-FES estimates. However, of all the non-sampling error series produced from MRIP, **AL Snapper Check and MS Tails n' Scales estimates are closest to the APAIS-only estimates.**



State-to-State Differences in Red Snapper Estimates

When we compare the estimates produced from the same, or similar, designs across states, the **relative state-to-state differences in red snapper landings are similar**.

Relative state-to-state **differences are larger when every state uses a different design**.

This suggests the consistent state-to-state pattern we see when using a single design across the region **is likely accurate**, but the use of different survey designs drives **systematic differences** in the estimates.

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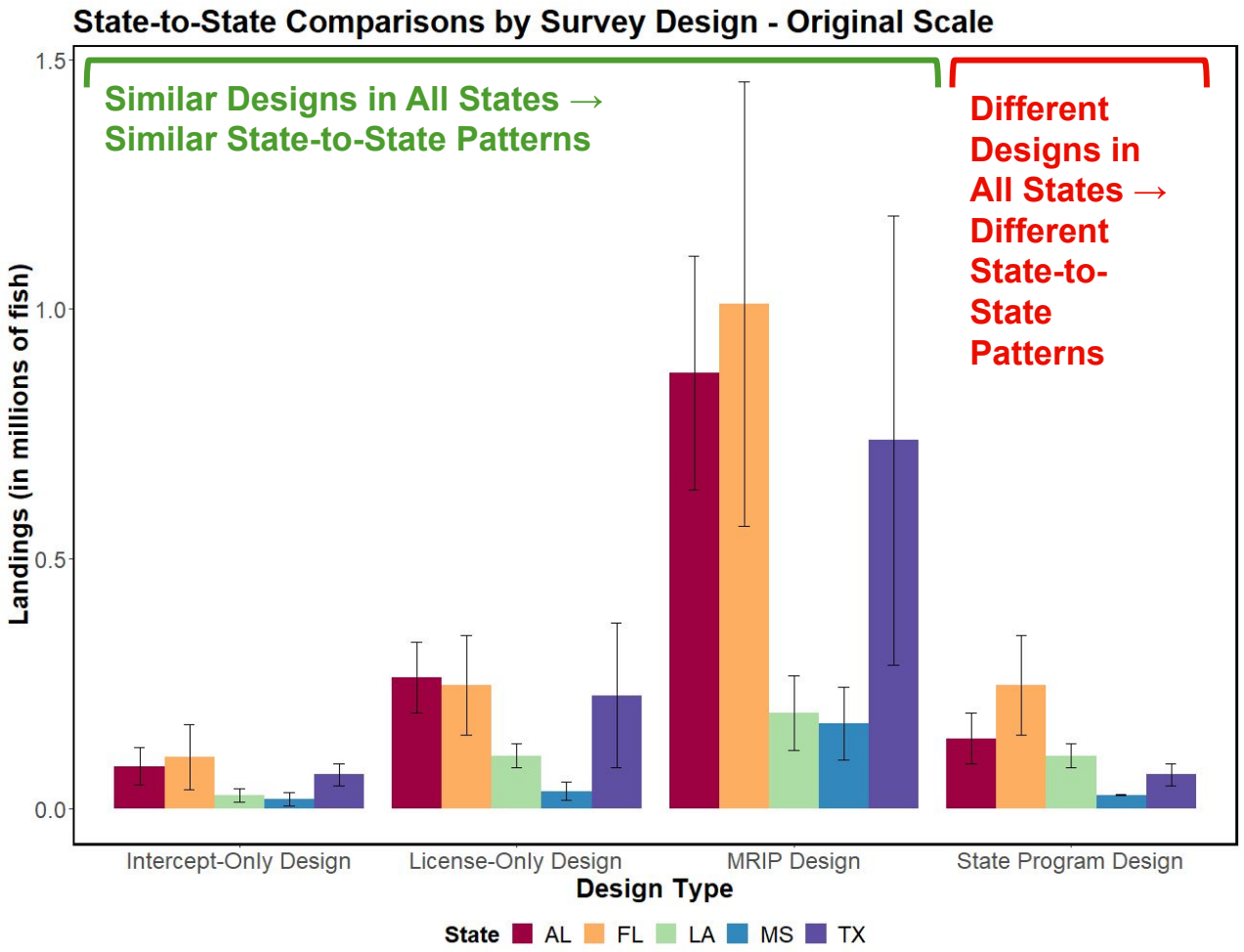
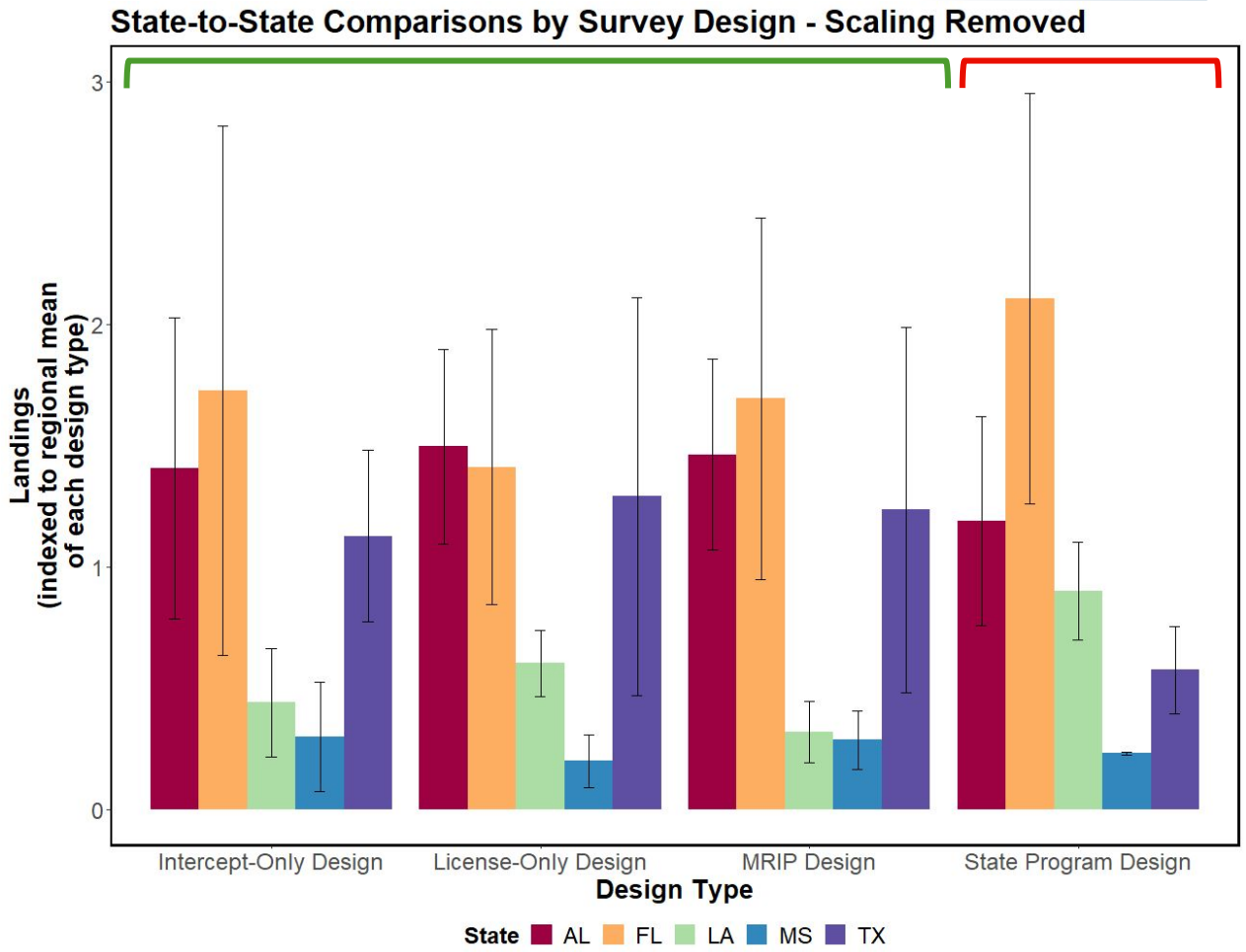
State-to-State Differences in Red Snapper Estimates (2019 Example)





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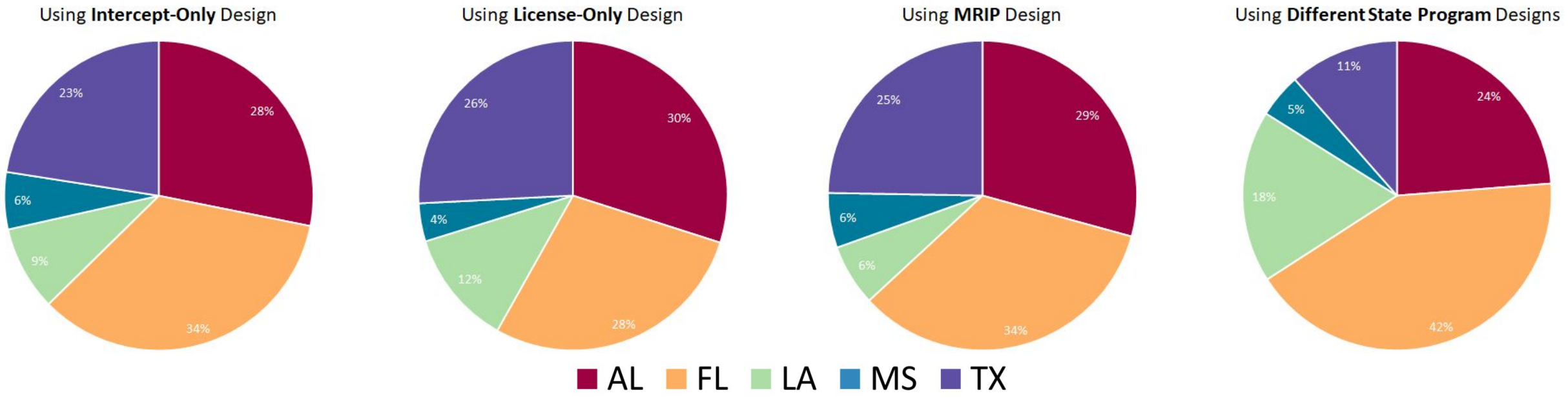
State Contributions to Regional Red Snapper Landings Estimate (2019 Example)



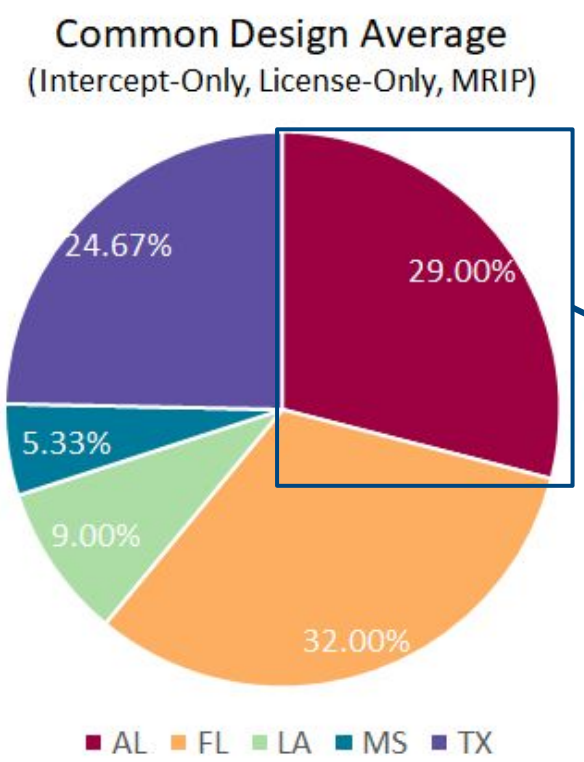
Use a Similar Design in All States →
See Similar Contributions to Regional Total

Use Different Designs in All States →
See Different Contributions to Regional Total

This suggests the consistent state-to-state pattern we see when using a single design across the region **is likely accurate**. However, the use of different survey designs drives **systematic differences** in the estimates, potentially masking the "true" pattern.

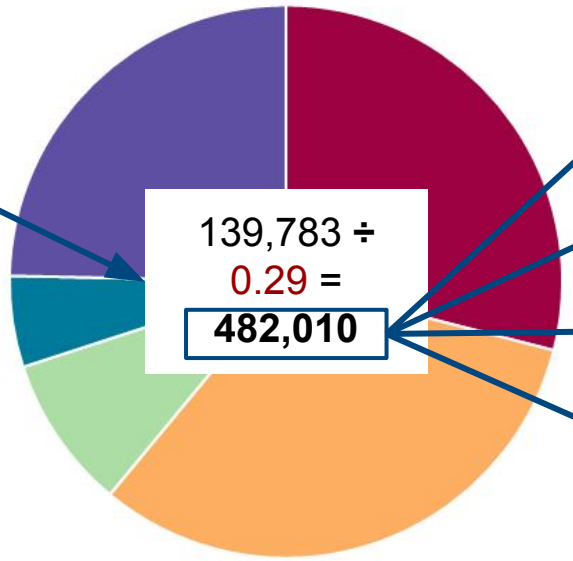
What if Individual State Surveys were Conducted in Other States?

Average the common design proportions (from the previous slide) → **Generate a regional estimate, scaled to an individual state design** → **Generate state estimates, based on their proportional contribution to the regional estimate**



Example: A regional estimate, scaled to Snapper Check

Snapper Check 2019 Landings = **139,783** fish



Example: FL, LA, MS and TX estimates, scaled to Snapper Check

FL: 482,010 ✖ 0.32 = **154,243**

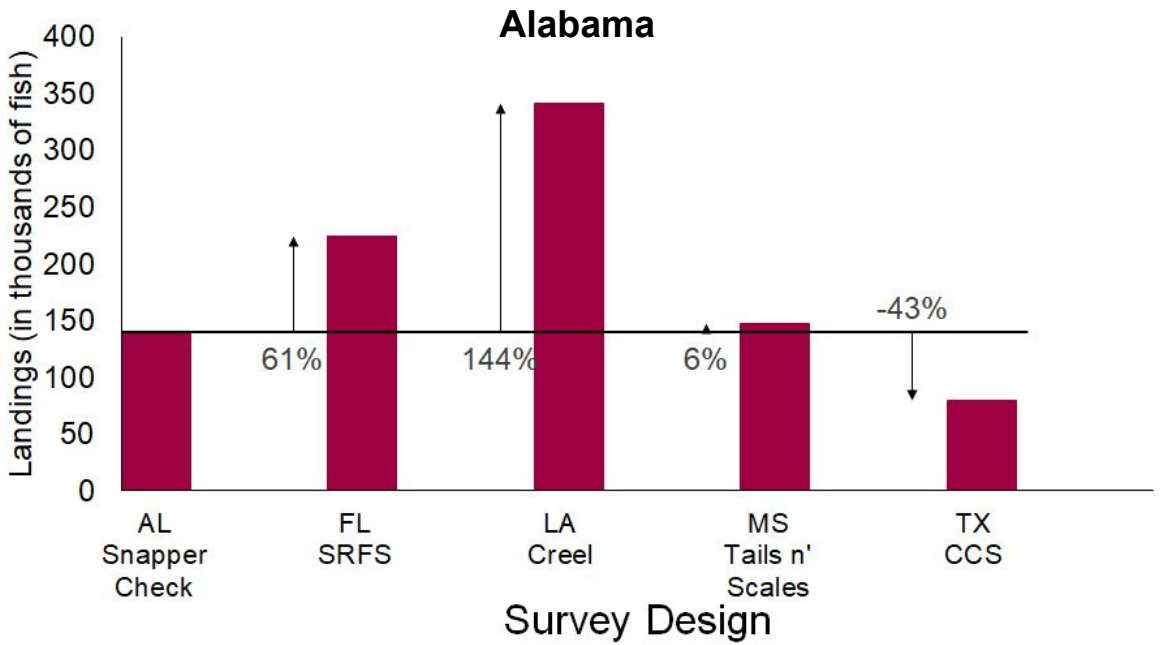
LA: 482,010 ✖ 0.09 = **43,381**

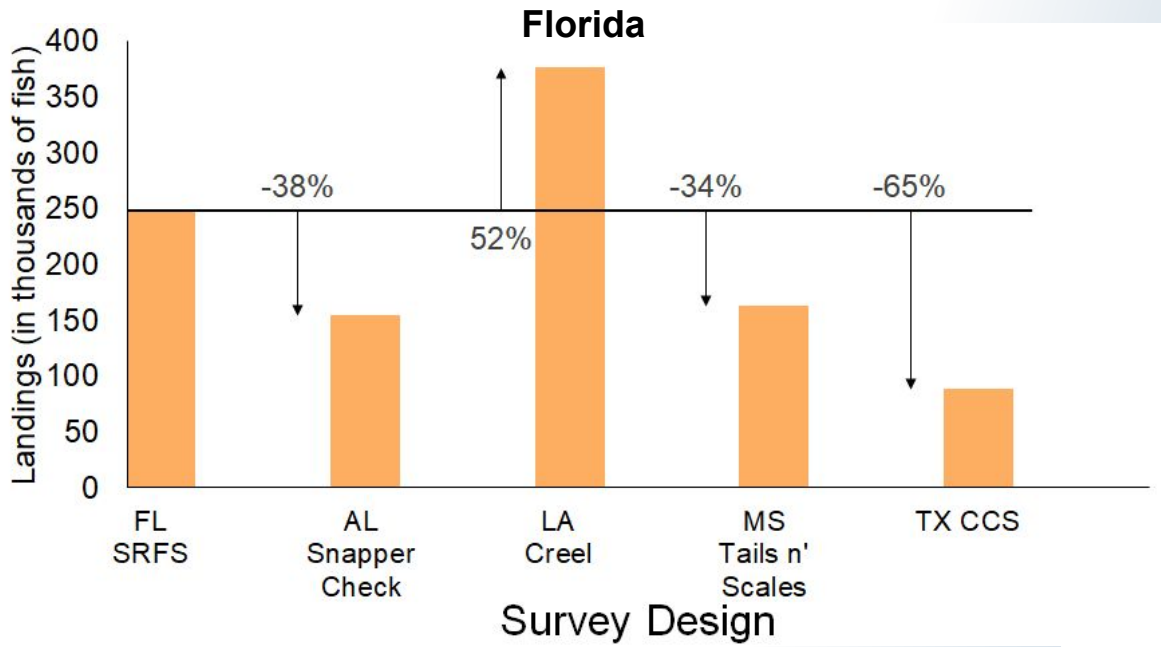
MS: 482,010 ✖ 0.0533 = **25,707**

TX: 482,010 ✖ 0.2467 = **118,896**

Going through this process for every state results in a set of estimates for each state, scaled to all the different state designs, effectively simulating if all individual state surveys were conducted side-by-side throughout the region.

Simulating All State Designs in All States (AL & FL - 2019)





- If all **five state survey designs** were conducted **side-by-side throughout the region**, we would have **five different red snapper estimates for each state**.
- Again, this is because **different survey designs** drive **systematic differences** in estimates.
- These results suggest that individual state program estimates are **not directly comparable**.

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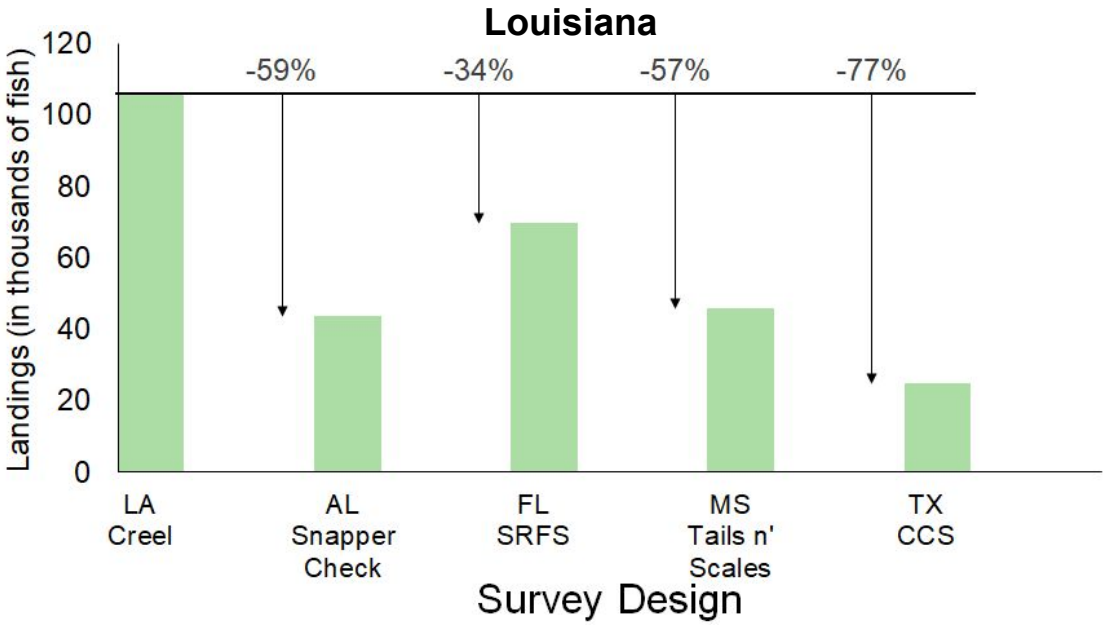
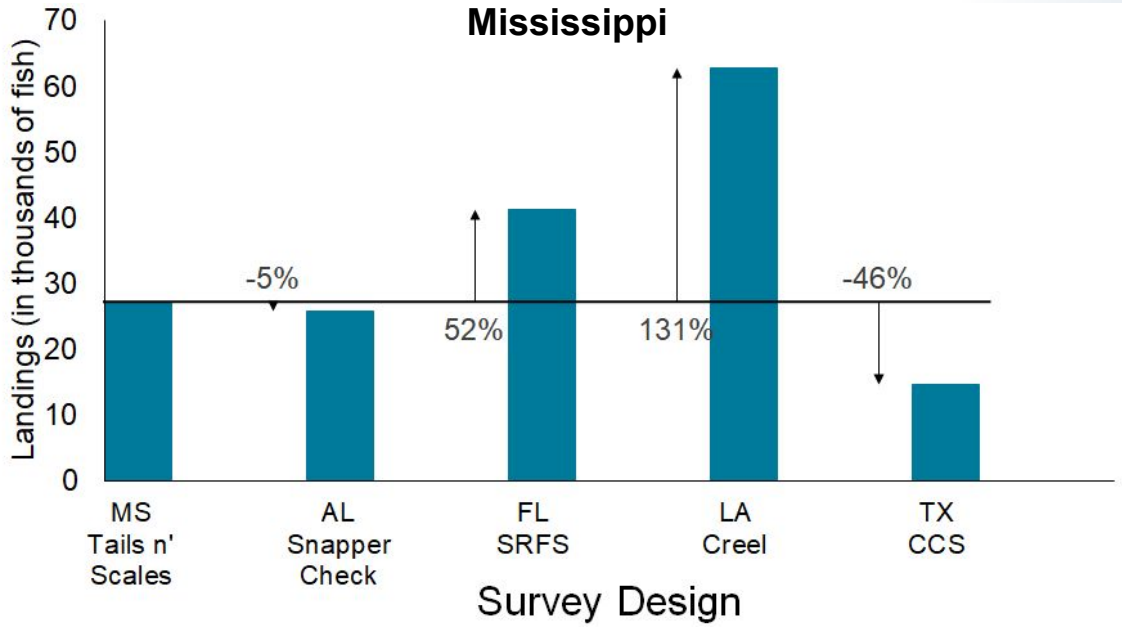
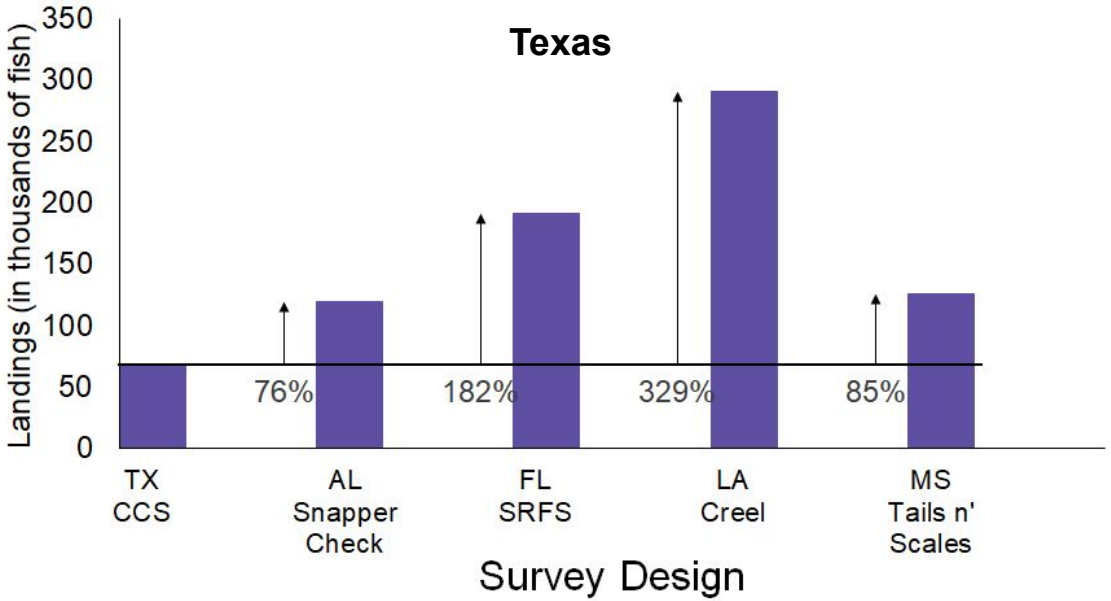
Simulating All State Designs in All States (LA, MS & TX - 2019)







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Gulf of Mexico Recreational Fishing Surveys — Non-sampling Error Summary

General Design	Survey Program	Methods	Potential Sources of Non-Sampling Error
Intercept survey at public access fishing sites coupled with offsite effort survey	**MRIP APAIS and FES** MS to FL	• Intercept survey coupled with a **mail survey** distributed to sample of residential households.	• Differences in trip characteristics between **public and private access sites** - no coverage of private access fishing in intercept component; Response error in FES (e.g., telescoping)
	MRIP APAIS and CHTS MS to FL	• Intercept survey coupled with a **telephone survey** of sample of residential households.	• **No coverage** of wireless-only households; No coverage of private access fishing in intercept component
	LA Creel LA	• Intercept survey coupled with **telephone and email surveys of licensed anglers**.	• **Incomplete coverage** of unlicensed fishing effort; No coverage of private access fishing in intercept component
	State Reef Fish Survey FL	• Intercept survey coupled with **a mail survey of licensed/subscribed anglers**.	• **Incomplete coverage** of unlicensed fishing effort; No coverage of private access fishing in intercept component
Intercept survey only	**Coastal Creel Survey** TX	• Intercept survey with anglers at public boat access sites.	• **No coverage** of private access fishing
Capture-recapture	**Tails n' Scales** MS	• **Capture:** Mandatory electronic trip reports of boats landing red snapper. • **Recapture:** Intercept survey with anglers to validate reports, measure reporting rates, and account for mis-reported or unreported trips.	• Differences in reporting and trip characteristics between **public and private access sites**- no coverage of private access fishing in intercept component • Violations to the **assumption of independence** in the capture and recapture phases of data collection
	Snapper Check AL		

Conclusions

- While **non-sampling errors exist in every large-scale real-world data collection**, these errors impact estimates in different ways and to different extents, especially if they cannot be accounted for as part of the data collection design.

- The results indicate that **non-sampling errors** can cause **large systematic differences** in estimates. However, this analysis is not definitive, does not rule out other possible sources of error, but does indicate that additional research is warranted.

- When we simulate the same designs across all states in the Gulf, we see similar patterns in relative estimate distributions across states suggesting differences in program designs among states may lead to comparability issues with the estimates.

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